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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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BLAKELY SOKOLOFF TAYLOR & ZAFMAN
12400 WILSHIRE BOULEVARD
SEVENTH FLOOR
LOS ANGELES, CA 90025-1030

EXAMINER

BAREFORD, KATHERINE A

ART UNIT	PAPER NUMBER
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1762

DATE MAILED: 12/11/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/749,776

Applicant(s)

DUBIN ET AL.

Examiner

Katherine A. Bareford

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 23 October 2006.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-34 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-9 and 31-34 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

claims 10-30 are canceled

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
 - ☐ Certified copies of the priority documents have been received in Application No. _____.
 - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO/SB/08)
Paper No(s)/Mail Date _____.
- 4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____.
- 5) ☐ Notice of Informal Patent Application
- 6) ☐ Other: _____.

DETAILED ACTION

1. The amendment of October 23, 2006 has been received and entered.

With the amendment, claims 10-30 remain canceled, and claims 1-9 and 31-34 are pending for examination.

Claim Rejections - 35 USC § 102

2. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless -

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

3. Claims 1-4, 31, 33 and 34 are rejected under 35 U.S.C. 102(b) as being anticipated by Holko (US 5358547).

Claim 1: Holko teaches a method of coating a substrate. Column 1, lines 30-35. The substrate can have a metal portion, as the substrate can be made from metal, and therefore, at least a portion of the substrate is metal. Column 6, lines 35-60 (the substrates are comprised of the listed alloys). A metal capping layer that comprises a

Group VIII metal (such as cobalt or nickel) is applied to the metal portion. Column 2, Table A (see Nicrobraz 125, 135 containing nickel), column 4, lines 20-60 and Table B (see coating alloys 5-7, containing alloys of cobalt, phosphorus, and Nicrobraz 125, 135), and column 6, lines 60-65. The capping layer can also contain C (carbon). Column 2, Table A (Nicrobraz 125, 135 contain carbon).

Claim 2: the Group VIII metal can be cobalt. Column 4, Table B, see alloys 5-7.

Claim 3: the capping layer can include a refractory metal such as chromium.
Column 2, Table A (Nicrobraz 125 contains chromium).

Claim 4: the capping layer can be applied by electroless plating which would provide contacting an electroless plating solution to the metal portion of the substrate.
Column 4, lines 50-55.

Claim 31: the cobalt/nickel can be alloyed with chromium. Column 2, Table A (Nicrobraz 125 contains chromium).

Claim 33: the metal capping layer can further comprise boron. Column 2, Table A (Nicrobraz 125, 135 contain boron).

Claim 34: the metal capping layer can further comprise phosphorus. Column 4, Table B, see alloys 5-7.

4. The rejection of claims 1, 2, 4-6, 33 and 34 under 35 U.S.C. 102(b) as being anticipated by Sambucetti et al (US 6573606) is withdrawn due to applicant's amendments of October 23, 2006.

Claim Rejections - 35 USC § 103

5. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

6. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

7. Claims 1, 2, 4-6, 33 and 34 are rejected under 35 U.S.C. 102(e) as anticipated by or, in the alternative, under 35 U.S.C. 103(a) as obvious over Besser et al (US 6689689)

Besser teaches a method of coating a substrate. Column 5, lines 50-65. The substrate can have a metal portion, as the substrate can contain copper metal interconnect lines in a layer of dielectric. Column 5, lines 55-60 and column 8, lines 15-40. A metal capping layer that comprises a Group VIII metal (such as cobalt or nickel)

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can be applied to the metal portion. Column 5, lines 60-65 and column 6, lines 25-40.

The capping layer can also contain C (carbon). Column 6, lines 25-40.

Claim 2: the Group VIII metal can be cobalt. Column 6, lines 25-40.

Claim 4: the capping layer can be applied by electroless plating which would provide contacting an electroless plating solution to the metal portion of the substrate. Column 6, lines 25-30 and column 9, lines 55-65.

Claim 5: the capping layer can be applied by the electroless plating for a time sufficient to provide a to a thickness of 50-200 angstroms. Column 9, lines 55-65 and column 10, lines 15-20.

Claim 6: the metal capping layer can be applied to copper interconnect lines. Column 1, lines 10-20.

Claim 33: the metal capping layer can further comprise boron. Column 6, lines 25-35.

Claim 34: the metal capping layer can further comprise phosphorous. Column 10, lines 1-5 (the sue of cobalt-phosphide solutions).

As to the 35 USC 102 rejection: Besser teaches as to the selection of the materials of the capping layer that can be deposited as at least one layer comprises "at least one" of the listed elements including cobalt, carbon and boron (column 6, lines 25-35) and that the layer can be deposited as including two or more alloying elements (column 10, lines 30-35), thus from the short list provided of materials, one would at once envision that materials to be applied would include one containing cobalt, carbon and boron.

As to the 35 USC 103 rejection: Besser teaches all the features of these claims except that the metal capping layer specifically includes at least each of cobalt and carbon, and also includes boron (claim 33) and/or phosphorous (claim 34). However, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify Besser to select the specific elements of cobalt, carbon, boron and phosphorous from the teaching that the selection of the materials of the capping layer that can be deposited as at least one layer comprises "at least one" of the listed elements including cobalt, carbon and boron (column 6, lines 25-35) and that the layer can be deposited as including two or more alloying elements (column 10, lines 30-35) and that phosphorous can also be present (column 10, lines 1-3), thus providing the teaching by Besser that multiple materials should desirably be selected from among the list given.

8. Claims 3 and 31 are rejected under 35 U.S.C. 103(a) as being unpatentable over Besser as applied to claims 1, 2, 4-6, 33 and 34 above, and further in view of Sambucetti et al (US 6573606).

Besser teaches all the features of these claims except that tungsten (a group VIB refractory metal) is alloyed with the other metals of the capping layer.

However, Sambucetti teaches providing cobalt containing capping layers to overcoat copper interconnects. Column 2, lines 30-50. Sambucetti further teaches that the capping layers can also contain other alloying ingredients can be combined with the cobalt, including W, Si, P, and B. Column 2, lines 40-50.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify Besser to further use tungsten in the capping layer as suggested by Sambucetti with an expectation of providing a desirable capping layer as Besser teaches to apply a metal capping layer that can contain cobalt and various other alloying elements, and Sambucetti teaches that when applying metal capping layers that contain cobalt, it is also well known to be desirable to include tungsten.

9. Claim 32 is rejected under 35 U.S.C. 103(a) as being unpatentable over Besser as applied to claims 1, 2, 4-6, 33 and 34 above, and further in view of Japan 2002-180261 (hereinafter '261).

Besser teaches all the features of this claim except that manganese (a group VIIB metal) is alloyed with the other metals of the capping layer.

VB However, '261 teaches that when plating printed circuit boards by non-electrolytic plating (electroless plating), it is well known to include ^{nickel,} cobalt and manganese. See the abstract.

VB It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify Besser to further use manganese in the capping layer as suggested by '261 with an expectation of providing a desirable capping layer as Besser teaches to apply a metal capping layer that can contain ^{nickel} cobalt and various other alloying elements, and '261 teaches that when applying metal layers over printed circuit boards that contain ^{nickel} cobalt, it is also well known to be desirable to include manganese.

10. Claims 7 and 9 are rejected under 35 U.S.C. 103(a) as being unpatentable over Besser as applied to claims 1, 2, 4-6, 33 and 34 above, and further in view of Endo et al (US 6071797).

Besser teaches all the features of these claims except using plasma enhanced CVD to incorporate C. Besser does teach that the listed materials, which include carbon and cobalt, can be applied by chemical vapor deposition. Column 9, lines 55-67.

Moreover, the capping "layer" can be applied in the form of two or more overlying layers that each include a single alloying element, and then the layer is subject to diffusion treatment that diffuses the alloying elements into the underlying metal interconnect. Column 10, lines 30-45. Thus, a layer of cobalt can be applied by electroless or CVD plating, followed by a layer of carbon by CVD plating and then all layers are diffused into the underlying copper layer, which provides that the carbon will be incorporated into the metal capping layer of cobalt during the diffusion.

However, Endo teaches that a well known method for applying carbon by a chemical vapor deposition (CVD) process is plasma enhanced CVD. Column 1, lines 5-15.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify Besser to further use plasma enhanced CVD to apply a carbon layer than becomes incorporated into the metal capping layer as suggested by Endo with an expectation of providing a desirable capping layer as Besser teaches to

apply a metal capping layer that can be cobalt by CVD followed by another CVD layer that can be carbon and diffusing the applied layers together with the metal interconnect layer, and Endo teaches that a desirable CVD method for applying carbon is plasma enhanced CVD.

11. Claim 8 rejected under 35 U.S.C. 103(a) as being unpatentable over Besser in view of Endo as applied to claims 7 and 9 above, and further in view of Sambucetti et al (US 6573606) and Qiao et al (US 6803318).

Besser in view of Endo teaches all the features of these claims except plasma enhanced chemical vapor deposition of silane is also used to incorporate Si into the capping layer.

However, Sambucetti teaches providing cobalt containing capping layers to overcoat copper interconnects. Column 2, lines 30-50. Sambucetti further teaches that the capping layers can also contain other alloying ingredients can be combined with the cobalt, including W, Si, P, and B. Column 2, lines 40-50.

Qiao teaches that a well known method of depositing silicon materials is to apply a silicide from plasma enhanced chemical vapor deposition of a silane source. Column 13, lines 35-55.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify Besser in view of Endo to further use silicon in the capping layer as suggested by Sambucetti with an expectation of providing a desirable

capping layer as Besser teaches to apply a metal capping layer that can contain cobalt and various other alloying elements, and Sambucetti teaches that when applying metal capping layers that contain cobalt, it is also well known to be desirable to include silicon. Moreover, it would have been obvious to modify Besser in view of Endo and Sambucetti to apply the silicon material by a plasma enhanced chemical vapor deposition method as suggested by Qiao in order to provide a desirable capping layer, given the suggestion of applying the materials as CVD applied individual layers and then diffusing together and the teaching by Qiao that it is well known to apply silicides by plasma enhanced chemical vapor deposition of a silane source.

12. The rejection of claims 1-2 and 7-9 under 35 U.S.C. 103(a) as being unpatentable over Qiao et al (US 6803318) is withdrawn due to applicant's amendments of October 23, 2006.

Response to Arguments

13. Applicant's arguments filed October 23, 2006 have been fully considered but they are not persuasive as to the 35 USC 102(b) rejection of claims 1-4, 31, 33 and 34 using Holko.

Applicant argues that Holko does not teach or suggest a substrate having a metal portion. The Examiner has reviewed these arguments, however, the rejection is maintained. Holko provides that the substrate can have a metal portion to the extent

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claimed, as the substrate can be made from metal, and therefore, at least a portion of the substrate is metal. See column 6, lines 35-60 (the substrates are comprised of the listed alloys).

14. Applicant's arguments with respect to claims 1-9 and 31-34 have been considered but are moot in view of the new ground(s) of rejection.

As to the claims as amended, the Examiner has withdrawn the 35 USC 102 rejection using Sambucetti and the 35 USC 103 rejection using Qiao alone.

However, the Examiner has provide a new rejection of claims 1-9 and 31-34 using Besser as provided above, alone or in combination with the other cited references as noted above. Besser provide the use of carbon and cobalt in a metal capping layer.

Conclusion

15. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO MONTHS** of the mailing date of this final action and the advisory action is not mailed until after the end of the **THREE-MONTH** shortened statutory period, then the

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shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

16. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Katherine A. Bareford whose telephone number is (571) 272-1413. The examiner can normally be reached on M-F(6:00-3:30) with the First Friday Off.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Timothy Meeks can be reached on (571) 272-1423. The fax phone numbers for the organization where this application or proceeding is assigned are (571) 273-8300 for regular communications and for After Final communications.

Other inquiries can be directed to the Tech Center 1700 telephone number at (571) 272-1700.

Furthermore, information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).


KATHERINE BAREFORD
PRIMARY EXAMINER